ZOLL M SERIES SERVICE MANUAL

Non-Invasive Blood Pressure

9653-0455-01 Rev. B

The issue date or revision level for this operation guide is shown on the front cover.
ZOLL and M Series are trademarks of ZOLL Medical Corporation.

© 2003 by ZOLL Medical Corporation. All rights reserved.

Table of Contents

PREFACE III
Conventions iii
Safety Considerations iv
Technical Service v

PRINCIPLES OF OPERATION 1
NIBP module 1
Blood pressure measurements 2
NIBP configuration 3

MAINTENANCE PROCEDURES 4
Required equipment 4
Recording your results 4
NIBP Monitor Test 5
NIBP Volume Leak Test 6
NIBP Transducer Calibration 8

DISASSEMBLY PROCEDURES 11
Removing the NIBP Module 11
Disassembling the NIBP Module 15
Removing the NIBP Interface Cable 18

REPLACEMENT PARTS 21
Ordering replacement parts 21
Parts and part numbers 21

TROUBLESHOOTING 22

Preface

ZOLL Medical Corporation's *M Series Service Manual* is intended for the service technician whose responsibility is to identify malfunctions and make repairs at the subassembly level. Place this insert into the three-ring binder containing the *M Series Service Manual* and all other M Series option inserts.

This document provides information required for maintenance of the Non-Invasive Blood Pressure (NIBP) option on the M Series unit, and contains the following sections:

Principles of Operation on page 1 — provides a general overview of NIBP functionality.

Maintenance Procedures on page 4 — describes procedures for verifying NIBP operation and integrity.

Disassembly Procedures on page 11 — describes procedures for removing the NIBP module from the M Series unit.

Replacement Parts on page 21 — lists the field-replaceable parts for the NIBP option and provides information on ordering replacement parts from ZOLL.

Troubleshooting on page 22 — describes all error messages related to NIBP functionality and their corresponding corrective action.

In addition, this document contains a copy of the ZOLL M Series Maintenance Test Checklist. Replace the current checklist in the *M Series Service Manual* with the checklist found at the back of this document.

Conventions

This M Series Service Manual uses the following conventions:

WARNING!	**Warning statements describe conditions or actions that can result in personal injury or death.**

CAUTION	Caution statements describe conditions or actions that can result in damage to the unit.

Note: Notes contain additional information on using the defibrillator.

Additional M Series documentation

For more information on M Series operation, see the following documents:

- *Non-Invasive Blood Pressure* (part number 9650-0214-01), insert to the M Series Operator's Guide — describes user tasks for operating the NIBP option on the M Series unit.
- *M Series Operator's Guide* (part number 9650-0200-01) — describes all the user tasks for general operation of the M Series unit.
- *M Series Configuration Guide* (part number 9650-0201-01) — describes the M Series features and functions whose operation can be customized by authorized users.

Safety Considerations

Service technicians should review these safety considerations prior to servicing any equipment and read the manual carefully before attempting to disassemble the unit. Only qualified personnel should service the M Series unit.

Federal (U.S.A.) law restricts this unit for use by or on the order of a physician.

Non-ZOLL manufactured accessories

Safety and effectiveness data submitted by ZOLL Medical Corporation to the Food and Drug Administration (FDA) under section 510(K) of the Medical Device Act to obtain approval to market is based upon the use of ZOLL accessories such as disposable electrodes, patient cables and batteries. The use of external pacing/defibrillation electrodes and adapter units from sources other than ZOLL is not recommended.

ZOLL makes no representations or warranties regarding the performance or effectiveness of its products when used in conjunction with pacing/defibrillation electrodes and adapter units from other sources. If unit failure is attributable to pacing/defibrillation electrodes or adapter units not manufactured by ZOLL, this may void ZOLL's warranty.

Warnings

All persons near the equipment must be warned to "STAND CLEAR" prior to discharging the defibrillator.

WARNING! The M Series unit can generate up to 4500 volts with sufficient current to cause lethal shocks.

Do not discharge the unit's energy internally more than three times in one minute or damage to the unit may result.

Do not discharge a battery pack except in a Base PowerCharger^{4x4}, a compatible ZOLL Battery Charging/Testing unit, or an M Series unit.

Do not use the M Series in the presence of flammable agents (such as gasoline), oxygen-rich atmospheres, or flammable anesthetics. Using the unit near the site of a gasoline spill may cause an explosion.

Do not use the unit near or within puddles of water.

Radio Frequency Interference (RFI)

The M Series is protected against interference from radio frequency emissions typical of two-way radios and cellular phones (digital and analog) used in emergency service/public safety activities.

Users of the M Series should assess the unit's performance in their typical environment of use for the possibility of radio frequency interference from high-power sources. Radio Frequency Interference (RFI) may be observed as shifts in monitor baseline, trace compression, or transient spikes on the display.

Technical Service

For terms and conditions associated with your warranty, consult your purchasing agreement (for customers in North America) or a ZOLL authorized representative (for customers outside North America).

To maintain this warranty, the instructions and procedures contained in this manual must be strictly followed. For more information, please contact ZOLL Medical Corporation at 1-978-421-9655 or the ZOLL Technical Service Department at 1-800-348-9011 (North America).

Contacting Technical Service

If the M Series unit requires service, contact the ZOLL Technical Service Department:

Telephone: 1-800-348-9011
1-978-421-9655

FAX: 1-978-421-0010

When requesting service for the M Series unit, please provide the following information available to the Technical Service representative:

- unit serial number
- description of the problem
- department using the equipment
- sample chart recorder strips documenting the problem, if applicable
- purchase order to allow tracking of loan equipment
- purchase order for a unit with an expired warranty

Returning a unit for service

If you need to send the unit to ZOLL Medical Corporation for repair, you must obtain a service request (SR) number from the Technical Service representative. Units are available on loan while your unit is being repaired.

For customers ...	Return the unit in its original container to ...
in the U.S.A.	ZOLL Medical Corporation 269 Mill Road Chelmsford, MA 01824-4105 Attention: Technical Service Department (SR number)
in Canada	ZOLL Medical Canada Unit #15 5266 General Road Mississauga, Ontario L4W 1Z7 Attention:Technical Service Department (SR number)
outside North America	the nearest authorized ZOLL Medical Corporation Service Center. To locate an authorized service center, contact the International Sales Department at ZOLL Medical at the above-noted address.

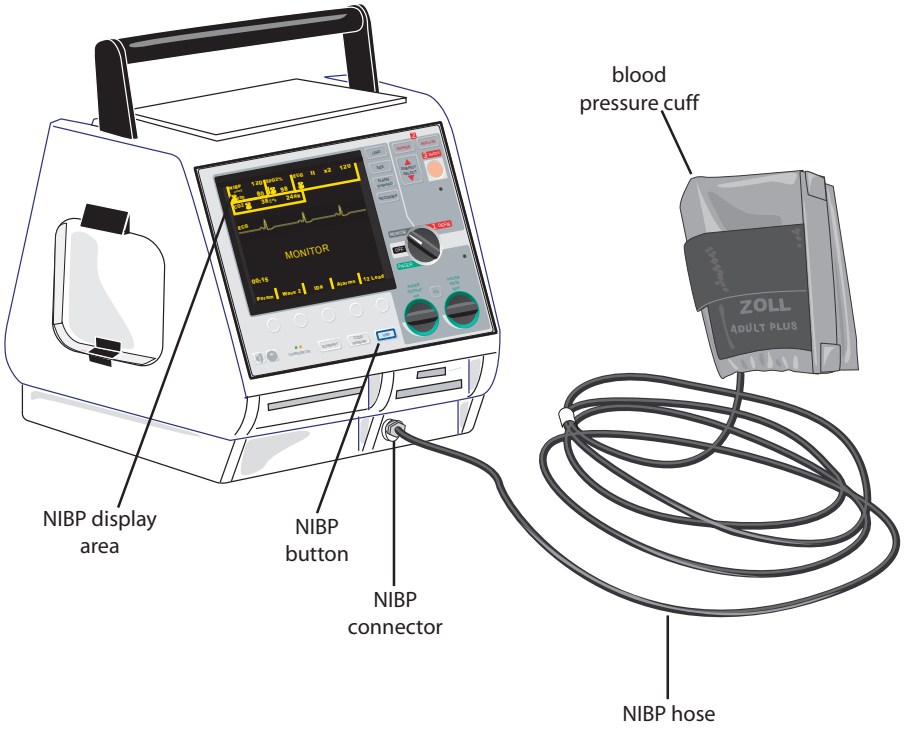
Principles of Operation

The Non-Invasive Blood Pressure (NIBP) option on the M Series provides non-invasive monitoring of blood pressure and pulse rate for adult and pediatric patients using the oscillometric method. The NIBP option functions in automatic interval, manual, and STAT modes.

NIBP module

The NIBP module resides in the lower housing assembly of the M Series unit. The patient blood pressure cuff and hose connect to the M Series unit through the NIBP connector on the front of the NIBP module. The NIBP button on the front panel of the M Series allows the user to initiate and terminate blood pressure measurements, which the M Series then displays in the NIBP display area on the monitor. The user can also initiate and terminate measurements from the NIBP softkey menu.

Figure 1-1: M Series with NIBP option



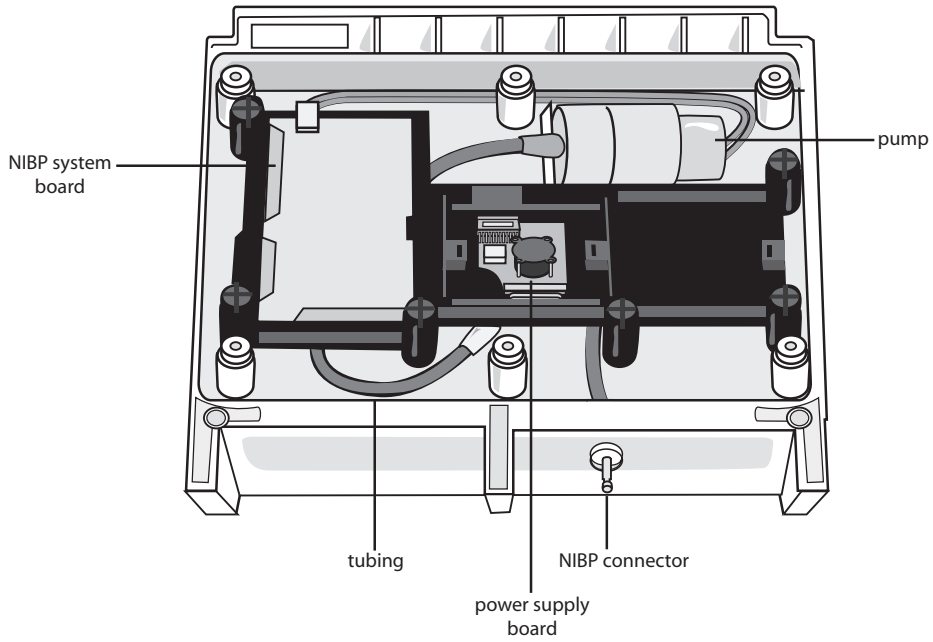
NIBP components

The NIBP module itself contains the following components:

- NIBP system board
- pump
- tubing assembly (single lumen)
- power supply board
- NIBP connector

These components measure the oscillometric pulses transmitted through the blood pressure cuff and hose, calculate blood pressure measurements accordingly, and transmit them to the main M Series unit.

Figure 1-2: NIBP module assembly



Blood pressure measurements

The NIBP module measures systolic, diastolic and mean arterial blood pressure in adult and pediatric patients, and calculates patient pulse rate (PR).

The M Series with NIBP option can take

- a single blood pressure measurement,
- STAT measurements (as many measurements as possible within a five-minute period, to a maximum of ten), or
- repeated blood pressure measurements at user-configurable intervals.

Measurement cycle

The M Series NIBP module measures arterial blood pressure oscillometrically. The blood pressure measurement cycle takes approximately 30 seconds, and proceeds as follows:

Stage	Description
1.	The internal pump inflates the cuff to a preconfigured pressure (configured default value is 160 mmHg), typically above the patient's systolic blood pressure, to occlude blood flow in the monitored limb.
2.	The cuff deflates automatically, in stages, to allow blood to flow past the cuff in the monitored limb.
3.	As blood flow resumes past the cuff, it produces pressure oscillations that are transmitted to the M Series unit through the hose.
4.	The NIBP system board measures the oscillometric pulses and uses them to calculate the corresponding systolic, diastolic and mean blood pressure, as well as the patient's pulse rate.

Stage	Description
5.	The M Series displays the blood pressure values on the monitor. However: • if the NIBP sensor cannot detect systolic pressure, the M Series automatically increases the cuff inflation pressure and completes the blood pressure measurement • if the M Series cannot detect systolic, diastolic or mean pressure after 180 seconds, the unit aborts the blood pressure measurement and deflates the cuff • if the M Series detects a fault, the unit displays a corresponding error message on the monitor and aborts the measurement **Note:** In automatic interval mode, the M Series does not initiate a new measurement until 30 seconds have elapsed since the end of the last completed measurement cycle.

See the *M Series Operator's Guide* insert for Non-Invasive Blood Pressure for details on operating the NIBP option.

NIBP configuration

You can change default settings for NIBP parameters such as units of measurement, initial cuff inflation, automatic measurement intervals, and alarm thresholds. See the *M Series Configuration Guide* for more information.

Maintenance Procedures

It is important that users conduct the Operator's Shift Checklist procedure at the beginning of every shift to maintain the M Series unit ready for immediate use. This checkout procedure can be completed in a few minutes and requires no additional test equipment. See the *M Series Operator's Guide* for the Operator's Shift Checklist.

For the NIBP option, a qualified biomedical technician should perform the following maintenance procedures every six months to ensure that the M Series NIBP function is operating properly:

- "NIBP Monitor Test" on page 5
- "NIBP Volume Leak Test" on page 6 (optional at 6 months, recommended annually)
- "NIBP Transducer Calibration" on page 8 (optional at 6 months, recommended annually)

Required equipment

You need the following equipment to complete each NIBP maintenance procedure:

- M Series unit with NIBP option (with fully-charged battery installed)
- Bio-Tek BP Pump NIBP Monitor Analyzer (or equivalent)

Note: For all NIBP maintenance tests, ensure that the ECG cable is not connected to the M Series unit. If the SpO_2 option is installed, make sure that the Masimo cable is **NOT** connected to the M Series unit

Recording your results

Photocopy the checklist at the back of the *M Series Service Manual* and use the copy to record the results of the maintenance tests.

As you complete each step in a procedure, mark the appropriate Pass/Fail/NA box, and keep the checklist for your maintenance file. Complete all the steps of the procedure before evaluating the test results.

19.0 NIBP Monitor Test

The NIBP monitor test verifies the accuracy of the systolic, diastolic and mean blood pressure measurements, as well as patient pulse rate calculation.

Before you begin

Before you begin the NIBP monitor test:

- Connect the NIBP Analyzer's simulator hose to the NIBP connector on the M Series unit.
- Set the following parameters on the NIBP Analyzer:

Parameter	Value
Systolic pressure	120 mmHg
Diastolic pressure	80 mmHg
Mean pressure	93 mmHg
Heart rate	80 bpm

Procedure

Follow these steps to perform the NIBP monitor test:

Step	Action	Expected Result
19.1	Set the selector switch on the M Series unit to **MONITOR**. (For AED units, turn the selector switch to **ON** and select Manual mode.)	The M Series powers on in MONITOR mode.
19.2	Ensure that the LEADS parameter is set to PADS (default value). You can cycle through the values for the LEADS parameter to PADS by pressing the **LEAD** button.	The M Series displays PADS in the Lead selection field of the monitor.
19.3	Press the **NIBP** button on the M Series front panel. Verify that the values displayed are accurate within ±5 mmHg of the pressure parameters set on the NIBP Analyzer.	The M Series initiates the blood pressure measurement cycle and displays the following measurements: • systolic pressure (115 - 125 mmHg) • diastolic pressure (75 - 85 mmHg) • mean pressure (88 - 98 mmHg)
19.4	Press the **SUMMARY** button on the M Series front panel.	
19.5	For software loads V22.55 and lower, select the **History** softkey. For software loads V30.00 and higher, select the **Trend** softkey, then select the **NIBP Trend** softkey.	The M Series displays a summary of the NIBP measurements, including the pulse rate reading (in the range of 77 - 83 bpm).
Record your results on the Maintenance Tests Checklist.		

20.0 NIBP Volume Leak Test

The volume leak test verifies the integrity of the pneumatic system on the NIBP module. This test is optional at six (6) months, but should be performed annually or every 10,000 readings, whichever comes first.

Before you begin

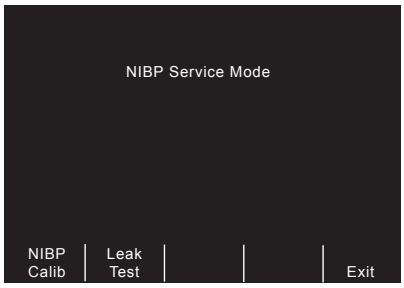
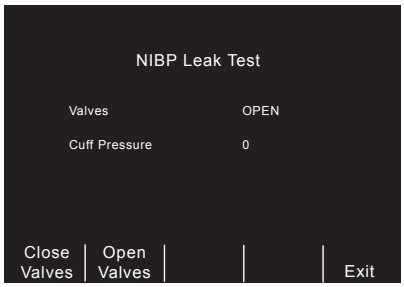
Before you begin the NIBP volume leak test:

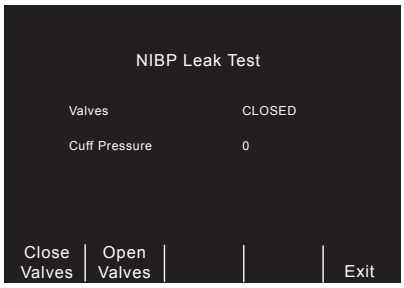
- Connect the NIBP Analyzer's simulator hose to the NIBP connector on the M Series unit.
- Configure the NIBP Analyzer for the volume leak test. For example, on the Bio-Tek BP Pump:
  - ⇨ Press the MODE button three (3) times to go into Tests Mode.
  - ⇨ Press the SELECT button twice to access the volume leak test.

  Note: These instructions apply to the Bio-Tek BP Pump; for equivalent devices, follow the manufacturer's instructions.

Procedure

Follow these steps to perform the NIBP volume leak test on the M Series unit.

Step	Action	Expected Result
20.1	Turn the selector switch to OFF. After 10 seconds, press and hold the fourth softkey from the left and turn the selector switch to MONITOR.	The M Series powers on in NIBP Service Mode. 
20.2	Press the **Leak Test** softkey.	The M Series displays the NIBP Leak Test screen. 
20.3	*On the NIBP Analyzer*, set the pressure parameter to 200 mmHg.	The NIBP Analyzer displays a pressure reading of 200 mmHg.

<table>
<tr><th>Step</th><th>Action</th><th>Expected Result</th></tr>
<tr><td>20.4</td><td>On the M Series unit, press the Close Valves softkey.</td><td>The “Valves” status changes from OPEN to CLOSED
 
</td></tr>
<tr><td>20.5</td><td>On the NIBP Analyzer, press the START TEST softkey.
Note: You must press the START TEST softkey within 30 seconds of closing the valves on the M Series unit.</td><td>After approximately 1 minute, a number appears in the upper middle area of the NIBP Analyzer display.
<table>
<tr><th>IF the NIBP Analyzer ...</th><th>THEN ...</th></tr>
<tr><td>displays a Volume Leak reading ≤ 4</td><td>the unit has passed the test.</td></tr>
<tr><td>displays a Volume Leak reading > 4</td><td>the unit has failed the test.</td></tr>
<tr><td>displays no Volume Leak reading, but maintains a stable pressure reading at or above 200 mmHg</td><td>the unit has passed the test; there is no volume leak.</td></tr>
</table>
In addition, the M Series displays the Analyzer’s pressure reading in the “Cuff Pressure” field.
After approximately 3 minutes, the valves on the M Series unit open.</td></tr>
<tr><td>20.6</td><td>On the NIBP Analyzer, press the STOP TEST softkey.</td><td>The NIBP Analyzer terminates the Volume Leak Test.</td></tr>
<tr><td>20.7</td><td>On the M Series unit, press the EXIT softkey twice.</td><td>The M Series returns to the main NIBP Service Mode screen, then to normal Monitor mode operation.</td></tr>
<tr><td colspan="3">Record your results on the Maintenance Tests Checklist.</td></tr>
</table>

21.0 NIBP Transducer Calibration

The NIBP module's pressure transducers are factory-calibrated prior to shipment. However, you can perform a two-point calibration procedure periodically to ensure accurate pressure measurements.

This procedure is optional at six (6) months, but should be performed annually or every 10,000 readings, whichever comes first.

Before you begin

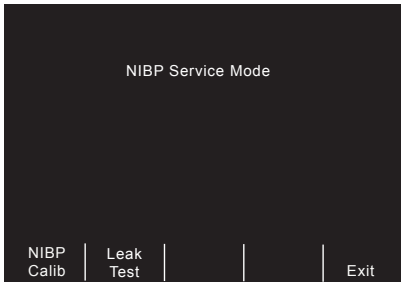
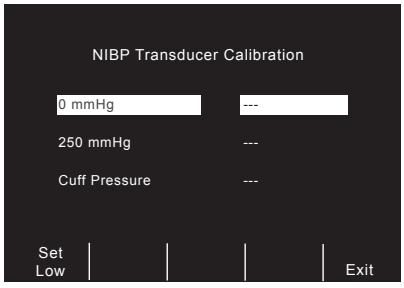
Before you begin the NIBP transducer calibration procedure:

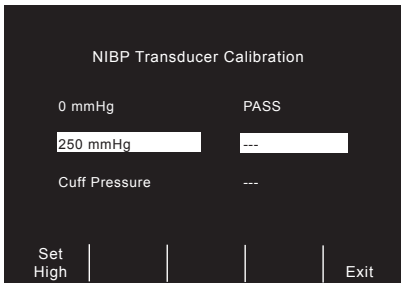
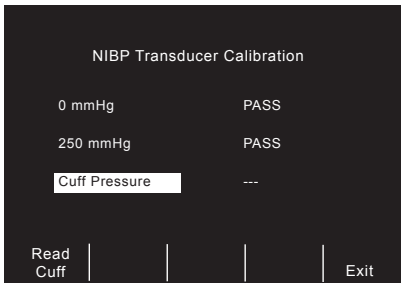
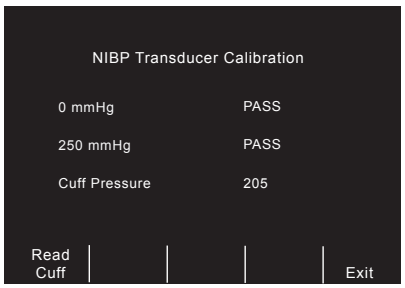
- Connect the NIBP Analyzer's simulator hose to the NIBP connector on the M Series unit.
- Configure the NIBP Analyzer to simulate cuff pressure. For example, on the Bio-Tek BP Pump:
  - ⇨ Press the MODE button three (3) times to go into Tests Mode.
  - ⇨ Press the SELECT button once to access the Pressure Simulator screen.

  Note: These instructions apply to the Bio-Tek BP Pump; for equivalent devices, follow the manufacturer's instructions.

Procedure

Follow these steps to calibrate the NIBP transducers on the M Series unit.

Step	Action	Expected Result
21.1	Turn the selector switch to OFF. After 10 seconds, press and hold the fourth softkey from the left and turn the selector switch to MONITOR.	The M Series powers on in NIBP Service Mode. 
21.2	Press the **NIBP Calib** softkey.	The M Series displays the NIBP Transducer Calibration screen. 
21.3	*On the NIBP Analyzer*, set the pressure parameter to 0 mmHg.	The NIBP Analyzer displays a pressure reading of 0 mmHg.

Step	Action	Expected Result
21.4	*On the M Series unit*, press the **Set Low** softkey to calibrate the transducer to a 0 mmHg pressure reading. **Note:** If the M Series displays a FAIL reading, verify the NIBP Analyzer's pressure setting and connection to the M Series and repeat the step.	The NIBP pressure transducer registers its voltage output at a known pressure of 0 mmHg. The field adjacent to the 0 mmHg value changes to PASS. 
21.5	*On the NIBP Analyzer*, set the pressure parameter to 250 mmHg.	The NIBP Analyzer displays a pressure reading of 250 mmHg.
21.6	*On the M Series unit*, press the **Set High** softkey to calibrate the transducer to a 250 mmHg pressure reading. **Note:** If the M Series displays a FAIL reading, verify the NIBP Analyzer's pressure setting and connection to the M Series and repeat the step.	The NIBP pressure transducer registers its voltage output at a known pressure of 250 mmHg. The field adjacent to the 250 mmHg value changes to PASS. 
21.7	*On the NIBP Analyzer*, set the pressure parameter to simulate a different cuff pressure (for example, 205 mmHg).	The NIBP Analyzer displays the specified pressure reading.
21.8	*On the M Series unit*, press the **Read Cuff** softkey. Verify that the value displayed is accurate within ±5 mmHg of the pressure parameter set on the NIBP Analyzer.	The NIBP module measures the pressure from the NIBP Analyzer and displays the value in the Cuff Pressure field. 
21.9	*On the M Series unit*, press the **Exit** softkey twice.	The M Series returns to the main NIBP Service Mode screen, then to normal Monitor mode operation.

Step	Action	Expected Result
21.10	Perform the NIBP Monitor Test (see “NIBP Monitor Test” on page 5) to verify functional operation of the NIBP option.	The M Series passes all criteria for the NIBP Monitor Test.
Record your results on the Maintenance Tests Checklist.		

Warning! NIBP transducer calibration can affect clinical readings of the NIBP parameter. Ensure that the NIBP Transducer Calibration procedure is performed correctly, followed by an NIBP Monitor Test to verify proper operation.

Disassembly Procedures

This section describes the following procedures:

- "Removing the NIBP Module" on page 11
- "Disassembling the NIBP Module" on page 15
- "Removing the NIBP Interface Cable" on page 18

Only properly trained technicians should service the M Series unit. Ensure that you take the appropriate safety precautions before disassembling any part of the M Series unit.

Warning!

SHOCK HAZARD!

Take necessary precautions to guard against shock or injury before conducting defibrillator tests or repairs. The M Series unit can contain lethal voltages even when turned off.

In addition:

- Discharge the unit before conducting any maintenance or repairs.
- Wear a conductive wrist strap that touches your skin and is connected to a grounding mat and to an earth ground when working with static-sensitive units. Remove the wrist strap when you discharge high voltage or when you are working on energized equipment.

Removing the NIBP Module

The NIBP module resides in the lower housing assembly of the M Series unit and connects to the main system board through the NIBP interface cable.

Required tools

You need the following tools to disassemble the NIBP module:

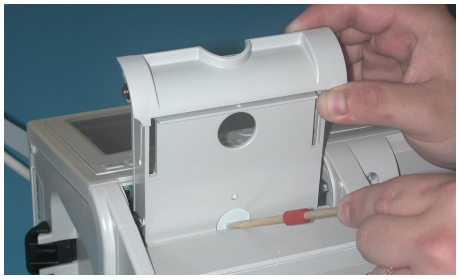
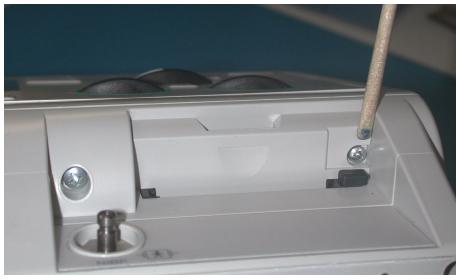
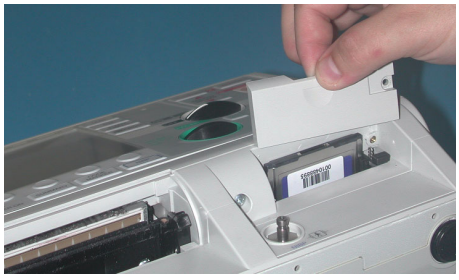
- #1 Phillips screwdriver
- #2 Phillips screwdriver
- small wood stick

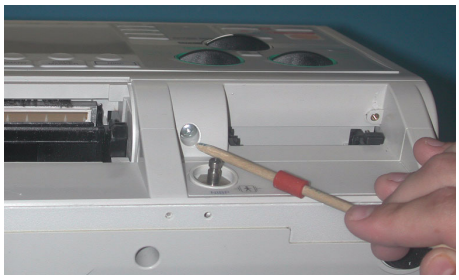
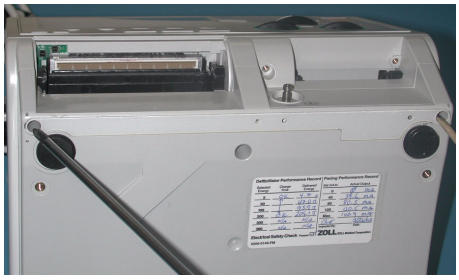
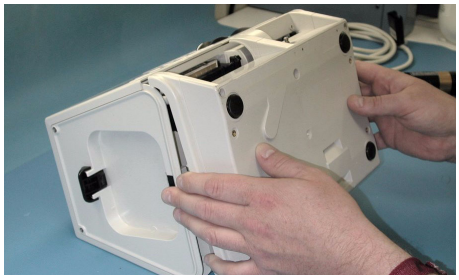
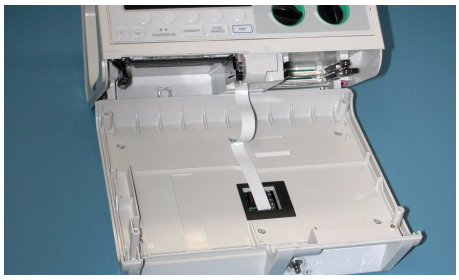
Before you begin

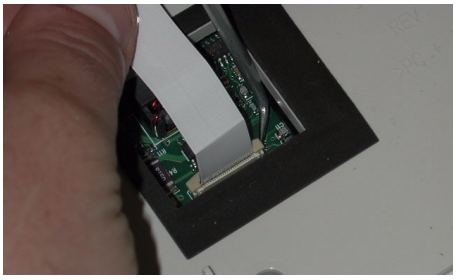
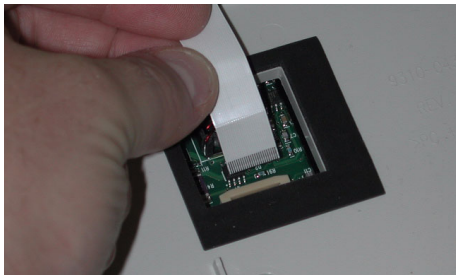
Remove all power sources, such as the battery and power cord.

Procedure

Follow these steps to remove the NIBP module from the M Series unit.

Step	Action	
1.	Rotate the unit onto its back side so that the bottom is facing you.	
2.	Remove the paper tray by pulling the tray out and pressing in and upwards on the locking tab at the rear of the tray.	
3.	Remove the #1Phillips screw beneath the PCMCIA FAX/modem slot on the right side of the unit.	
4.	Remove the plastic bezel covering the PCMCIA FAX/modem slot.	
5.	If installed, remove the PCMCIA FAX/modem card from the unit.	

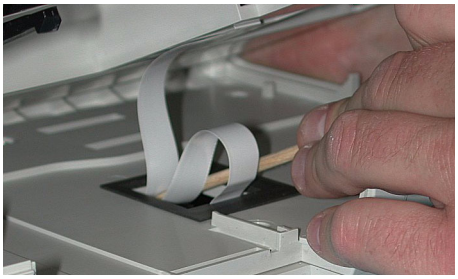
Step	Action	
6.	Remove the #2 Phillips screw to the left of the PCMCIA FAX/modem slot.	
7.	Remove the two #2 Phillips screws (closest to the front of the unit) on the bottom of the NIBP module.	
8.	Remove the two #2 Phillips screws (closest to the back of the unit) on the bottom of the NIBP module.	
9.	Gently pull the NIBP module up, being careful to clear the PCMCIA FAX/modem card slot, and away from the bottom of the M Series unit.	
10.	Lay the NIBP module on a flat surface. Support the main chassis of the M Series unit on the NIBP module to avoid putting tension on the NIBP interface cable.	

Step	Action	
11.	On the NIBP module, lift the Press-Fit fixtures on either side of the NIBP interface cable to release the cable.	
12.	Disconnect the NIBP interface cable from the NIBP module.	
13.	Detach the NIBP module from the M Series unit.	

Reinstalling the NIBP module

To reinstall the NIBP module reverse Steps 1 through 13 of the above disassembly procedure.

Note: When re-attaching the NIBP module to the main M Series chassis, carefully fold the NIBP interface cable into the NIBP module slot before closing the unit.



Disassembling the NIBP Module

The internal NIBP assembly resides in the NIBP module and comprises the following components:

- NIBP system board
- pump and tubing assembly
- power supply board
- frame support

Required tools

You need the following tools to disassemble the NIBP module:

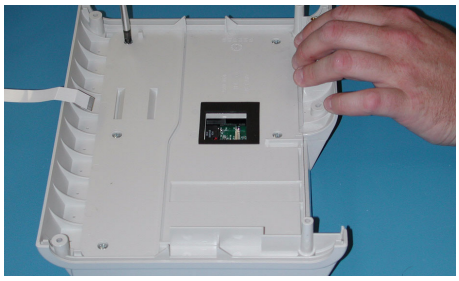
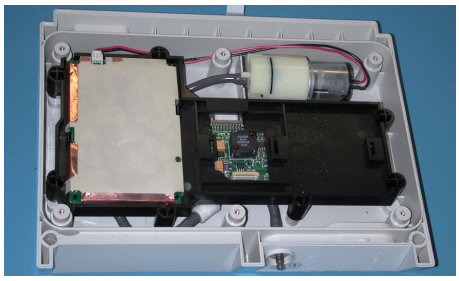
- #2 Phillips screwdriver
- small wood stick
- anti-static wrist strap

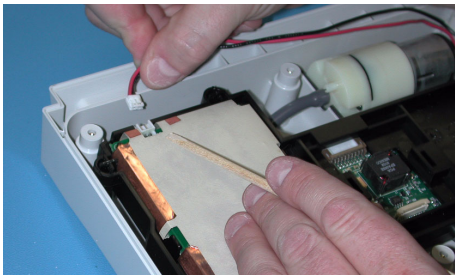
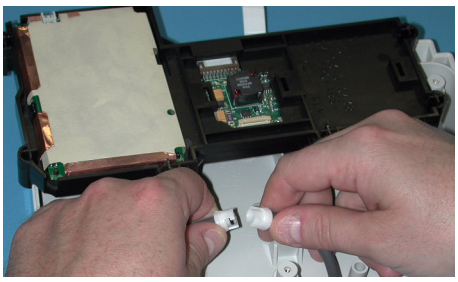
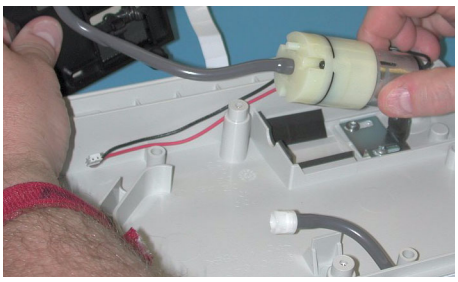
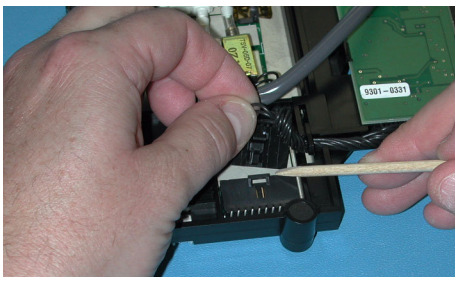
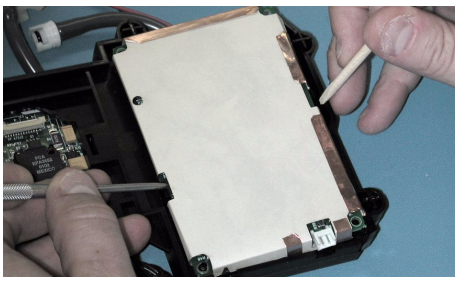
Before you begin

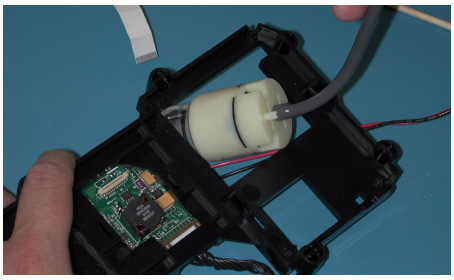
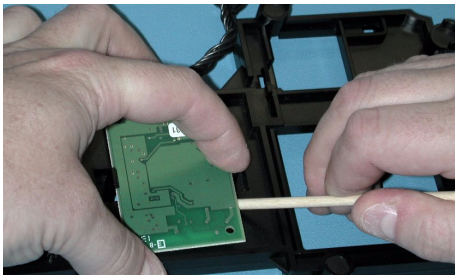
Remove the NIBP module from the M Series unit (see "Removing the NIBP Module" on page 11).

Procedure

Follow these steps to disassemble the NIBP module.

Step	Action	
1.	Remove the six (6) screws from the top of the NIBP module cover.	
2.	Gently lift the cover away from the NIBP module to expose the internal NIBP assembly.	

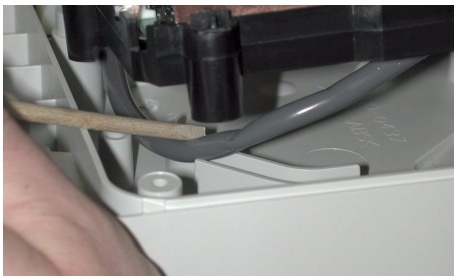
Step	Action	
3.	Disconnect the pump from the NIBP system board.	
4.	Lift the NIBP frame support assembly away from the NIBP module and disconnect the tubing assembly (near the NIBP connector).	
5.	Lift the pump assembly out of the NIBP module.	
6.	Disconnect the power supply board and lift the wires out of the guides on the NIBP frame support.	
7.	Turn the NIBP frame support assembly over and press outward on the mini-snaps on either side of the NIBP system board to release it.	

Step	Action	
8.	Pull the NIBP pump through the NIBP frame support.	
9.	Turn the NIBP frame support assembly over again. Press the tabs on either side of the power supply board to release it, gently lifting the power supply board from underneath with the wood stick.	

Reinstalling the NIBP internal assembly

To reassemble the NIBP module, reverse Steps 1 through 9 of the above disassembly procedure.

Note: When re-inserting the pump and tubing assembly into the NIBP module, place the tubing gently into the plastic guides to avoid pinching.



Removing the NIBP Interface Cable

The NIBP interface cable allows the NIBP module to communicate with the M Series unit, and connects to the M Series main system board.

Required tools

You need the following tools to disassemble the NIBP module:

- #2 Phillips screwdriver
- anti-static wrist strap
- orange wood stick

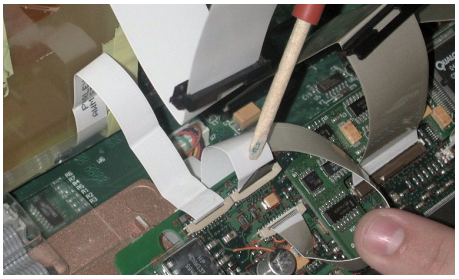
Before you begin

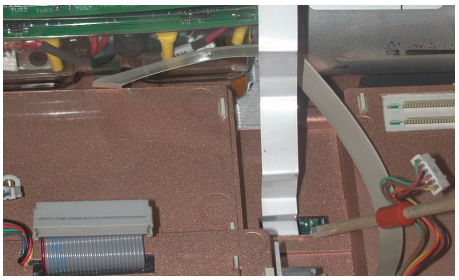
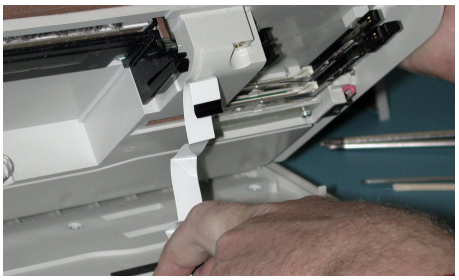
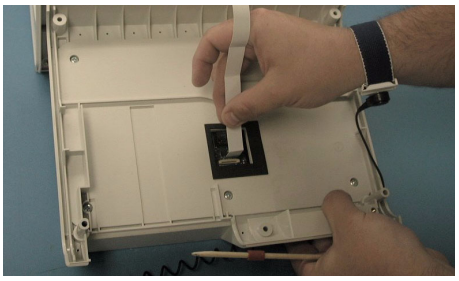
Remove all power sources, such as the battery and power cord.

CAUTION Ensure that you are familiar with the procedure for **removing the ZIF Keeper**; damage to the unit may result if not performed correctly. See the *M Series Service Manual* (Chapter 3: Disassembly Procedures) for more information

Procedure

Follow these steps to remove the NIBP interface cable from the M Series unit.

Step	Action	
1.	Remove the upper and lower housing assembly screws from the M Series unit.	Refer to Steps 6 through 8 of "Removing the NIBP Module" on page 13.
2.	Remove the front panel from the M Series unit.	Refer to the *M Series Service Manual*, “Removing the Front Panel” (Chapter 3: Disassembly Procedures).
3.	Remove the upper housing from the M Series unit.	Refer to the *M Series Service Manual*, “Removing the Upper Housing Assembly” (Chapter 3: Disassembly Procedures).
4.	Remove the main system board from the M Series unit.	Refer to the *M Series Service Manual*, “Removing the System Board Assembly” (Chapter 3: Disassembly Procedures).
5.	With the main system board lowered away from the M Series unit, disconnect the NIBP interface cable from the main system board.	

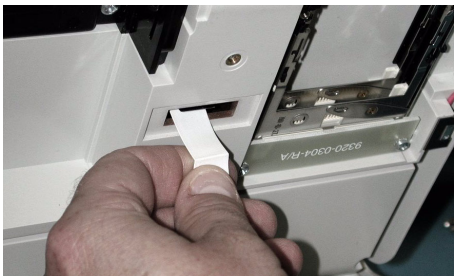
Step	Action	
6.	Remove the system interconnect board from the M Series unit. Note that the NIBP interface cable is threaded through the bottom of the M Series main chassis.	Refer to the *M Series Service Manual*, “Removing the System Interconnect Board” (Chapter 3: Disassembly Procedures). 
7.	Lift the M Series main chassis and gently pull the disconnected NIBP interface cable through the bottom of the chassis.	
8.	Disconnect the NIBP interface cable from the NIBP module.	Refer to Steps 11 and 12 of "Removing the NIBP Module" on page 14. 

Reinstalling the NIBP interface cable

To reinstall the NIBP interface cable, reverse Steps 1 through 8 of the above disassembly procedure.

CAUTION Ensure that you are familiar with the procedure for **removing the ZIF Keeper**; damage to the unit may result if not performed correctly. See the *M Series Service Manual* (Chapter 3: Disassembly Procedures) for more information

Note: When re-connecting the NIBP cable to the main system board, gently thread the NIBP interface cable through the bottom of the M Series main chassis.



Replacement Parts

You can order replacement parts through an authorized ZOLL distributor or directly from ZOLL Medical Corporation. Pricing information is available from ZOLL Medical Corporation's Technical Service Department.

Note: ZOLL reserves the right to substitute different parts to reflect modifications and improvements in ZOLL M Series circuitry and design.

Ordering replacement parts

When ordering parts, please provide the following information:

- ZOLL M Series device model and serial number
- field-replaceable unit part number
- description of the replacement part

By mail

To order by mail from ZOLL Medical Corporation, address your request to:

ZOLL Medical Corporation
269 Mill Road
Chelmsford, MA 01824-4105

Attention: Technical Service Department

By phone

For more information, contact ZOLL Medical Corporation at 1-978-421-9655 or 1-800-348-9011 (Fax: 1-978-421-0010).

Parts and part numbers

The following table lists the replacement parts available with the NIBP option on the M Series unit.

Table 22: NIBP Replacement Parts

Description	Part Number
NIBP module	1001-0229
NIBP Suntech assembly (includes PCB, pump, and tubing)	1001-0267
NIBP power supply board (for units with NIBP option only)	9301-0331
NIBP/IBP/Temperature power supply board (for CCT units with the IBP and Temperature options)	9301-0349
NIBP frame support	9310-0822
NIBP hose connector	9330-0517
NIBP interface cable	9500-0570

Troubleshooting

The M Series unit displays certain error messages to alert the user to problems detected in the NIBP module operation. The following table lists the NIBP error messages and the associated corrective action.

For further assistance, contact ZOLL Technical Service at 1-800-348-9011. International customers should call the nearest authorized ZOLL Medical Corporation distributor.

Table 23: NIBP Error Messages

Message/Symptom	Possible Causes	Corrective Action
CALIBRATE NIBP	NIBP calibration incomplete or failed.	Recalibrate NIBP (see "NIBP Transducer Calibration" on page 8.)
NIBP COMM ERROR	Communication problem with NIBP module.	Cycle power and retry. If problem persists, return for service.
NIBP FAULT	No communication from the NIBP module. NIBP module failed self-test.	Cycle power and retry. If problem persists, return for service.
NIBP MEAS ABORTED	Cuff inflation pressure set too high for attached cuff. Inflation too fast. M Series unable to find systolic value for 180 seconds. Defibrillator charged or charging. User-initiated abort.	Ensure that the defibrillator is not charging. Verify the cuff size. Check cuff and hose for blockages. If problem persists, return for service.
NIBP NOT READY	Less than 30 seconds elapsed since the end of the last measurement in auto-interval mode. Defibrillator charged or charging. NIBP module performing self-test after power-up.	Wait 30 seconds after the end of the last measurement before taking the next measurement. Wait until the defibrillator discharges or dumps before taking the next measurement. Wait for more than 10 seconds after power up before taking blood pressure measurements.
NIBP OUT OF RANGE	The data from the NIBP module is out of range.	Measure patient's blood pressure with other equipment. Check cuff fit and position. Switch cuff to other arm. If problem persists, return for service.
REPEAT NIBP MEAS	Exceeded maximum number of inflation attempts. Exceeded 180 second measurement time limit.	Check cuff and hose. Repeat NIBP measurement.

Message/Symptom	Possible Causes	Corrective Action
REPEAT NIBP MEAS alternating with CHECK CUFF/HOSE	Blood pressure cuff or hose not installed correctly.	Check cuff connection to hose. Check hose connection to unit. Check for kinked hose or air leaks in hose. If problem persists, replace cuff then hose.
REPEAT NIBP MEAS alternating with NIBP ARTIFACT	M Series unable to detect systolic, diastolic or mean blood pressure due to excessive motion or vibration.	Take a single blood pressure measurement. Keep patient as still as possible. Insulate patient and cuff from outside vibrations as much as possible.
REPEAT NIBP MEAS alternating with NIBP SIGNAL WEAK	Weak or no oscillometric signal.	Check cuff fit and positioning. Check hose connection to unit. Check for kinked hose. Increase cuff inflation pressure if clinically appropriate.
SYSTEM FAULT	Communication problem with the NIBP module.	Cycle power and retry. If problem persists, return for service.
False high reading	Cuff too small. Cuff not centered over brachial artery. Cuff too loose. Patient's limb below level of heart. Transducer requires calibration.	Select larger cuff. Readjust cuff. Reapply cuff or select smaller cuff. Raise patient's limb to heart level. Recalibrate NIBP (see "NIBP Transducer Calibration" on page 8).
False low reading	Cuff too large. Transducer requires calibration. Limb above level of heart.	Select smaller cuff. Recalibrate NIBP (see "NIBP Transducer Calibration" on page 8). Lower patient's limb to heart level.